

AD 606699

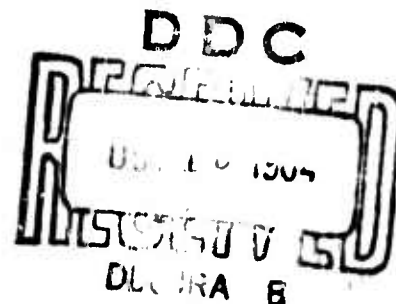
30-P

COPY	2	OF	3	61
HARD COPY	\$ . 2.00			
MICROFICHE	\$ . 0.50			

ECONOMICS OF DEFENSE

Roland N. McKean

July 1964



P-2926

Approved for OTS release

Copyright © 1964  
The RAND Corporation

ECONOMICS OF DEFENSE

by

Roland N. McKean

The RAND Corporation, Santa Monica, California

PREFATORY NOTE

This is an article intended for the International Encyclopedia of the Social Sciences, and it therefore follows the format desired by the editors, including the form of the bibliographic entries. (The references in the text refer to items in the bibliography.)

Any views expressed in this paper are those of the author. They should not be interpreted as reflecting the views of The RAND Corporation or the official opinion or policy of any of its governmental or private research sponsors. Papers are reproduced by The RAND Corporation as a courtesy to members of its staff.

## ECONOMICS OF DEFENSE

by

Roland N. McKean

Defense is one of the most important industries in the modern world. Its cost is enormous--\$50 billion worth of resources per year (as of the early 1960s) in the United States alone. Its output is vital; for the product can be anything from reasonable security to virtual annihilation.

Although the setting for defense planning varies from nation to nation, the economic issues are similar everywhere. It is essential to see defense as an economic problem and to understand what economizing means. It can also be important for nations to use an economic calculus (quantitative economic analysis) in making choices and to shape the institutional arrangements in defense with care.

### The Economic Problem in Defense Planning

Choosing among possible defense activities can be viewed as an economic problem: that of shifting resources around so as to get the greatest good from them. The alternatives include various sizes of the defense budget, i.e., various allocations of resources among defense, other governmental functions, and the private sector. The alternatives include allocations of the total budget among particular "outputs" or missions, such as nuclear

and repairs, he is dealing with the worth of these resources in rival uses.

Needless to say, the choices at different levels are not independent of each other. The size of the budget should depend upon, among other things, the costs and gains of producing specific capabilities, i.e., the specific lower-level options that confront a nation. The choices at lower levels should often depend in turn upon the size of the budget.

Another set of alternatives embraces various kinds of research and development intended to invent new defense policies or systems. Efficient resource allocation within any given technology, and effective attempts to advance technology, are both important; the absence of either would leave defense or any other activity at a fairly primitive stage. Because relatively great uncertainties surround research and development alternatives, choosing among them calls for a different approach from decision-making under conditions of comparative certainty (Klein & Meckling 1958; Nelson 1961).

#### Economizing in Making Defense Choices

Economizing does not imply scrimping and penny-pinching in defense (or in any other activity), nor does it call for meeting all "needs." Instead,

economizing implies cutting defense costs whenever resources can produce more valuable outputs elsewhere and meeting defense needs whenever they are more important than other needs.

Many persons believe, or talk as if they believe, in "needs" or "requirements" that should be met regardless of cost. Others seem to believe in cost or budget ceilings that must be adhered to, no matter how large the gains that might be obtained by going above the ceiling. Still others believe that one should set up priority lists like the following: (1) laser, (2) new supersonic bomber, (3) improved long-range camera. What such a list means is hard to see. Should all resources go to the first item? Should resources go to the first item until an extra dollar there brings zero return, even though the other items are worth something? Does it mean that more money should be spent on the first item than on the second and more on the second than on the third? The trouble is that a priority list does not face the real question: how much should be allocated to each item.

None of these beliefs gives proper guidance. Hard though it may be to apply, the economic principle is the one to keep in mind: make any resource shift that yields more than it costs. (When gains exceed costs, transfers of resources produce net gains

and thus a greater total output.) To the application of this principle there are two major approaches-- (1) improvement of the economic calculus (information about the costs and gains from alternative courses of action), and (2) improvement of the institutional arrangements that shape defense choices. As in the private economy, both are important. Identification of the correct choice will not help much if institutions are such as to lead decision-makers to make a different choice. On the other hand, better institutions are hard to devise if good choices cannot be identified. In making good decisions at every level--decisions about the size of budgets and about the allocation of given budgets--both the institutional arrangements and the economic calculus play an important role.

#### Economic Calculus and Economizing

First of all, what does economic efficiency really mean? If one could calculate all gains and costs in commensurable terms, if the amounts were universally and unambiguously true, and if there were no uncertainties, the correct actions would be those that yielded net gains, and they could be conclusively identified. In most activities, certainly in defense, these conditions do not hold. One major stumbling block is the fact that there is no generally accepted value that can be assigned

to a change in the amount of defense as a whole or to an increment in any defense mission.

We can sometimes derive a production-possibility curve showing the various combinations of two defense outputs, say ability to shoot down enemy missiles and ability to retaliate, with the same total budget. But we have no indifference curves, and no price tags, to show how extra units of each capability should be valued. It is impossible, therefore, to identify the most valuable or optimal combination. (Even the most valuable combination would not necessarily be optimal, because there would be no assurance that the given budget was optimal.)

By exploring alternative ways of using the resources, however, one can sometimes show how to obtain more of one capability without sacrificing any of the other. Such a change is an unambiguous improvement (assuming there are no uncounted effects). In technical terminology, this constitutes moving to an "efficient point" on the production-possibility curve.

Moreover, when alternative actions affect only a single objective (seldom completely true), one can sometimes find a closely related type of improvement. By designing and comparing alternative

ways to achieve that objective, one can often discover ways to achieve a specified amount of the objective at a lower cost or ways to achieve a larger amount of the objective at a specified cost. Such an improvement is akin to a shift toward an efficient point, because again the final result is the following: more of some desirable output can be produced without giving up anything else. This is the customary meaning of economic efficiency.

Program budgeting. One device that is intended to facilitate the economic calculus for budgetary choices is program budgeting, which the U.S. Defense Department introduced in 1961. The central feature is the presentation of costs for programs or "output" categories (e.g., retaliatory capability, weapon systems, arms control) rather than for input categories (e.g., personnel, transportation). By thinking in terms of programs, officials can better take into account interdependencies such as the effects of buying submarine-launched missiles on the worth of extra land-based ballistic missiles. Officials can presumably make better subjective judgments about the worth of output categories, or of changes in their amounts, than they can make about the worth of inputs. Also quantitative calculations can provide better clues to the worth of

increments or decrements in output categories.

Another feature of program budgeting is the presentation of the anticipated costs of a program decision for several years ahead rather than for one year ahead. This should help officials take into account the full-cost implications of decisions instead of merely the "down-payment" implications.

Program budgeting is no panacea. Hard choices will still be relatively hard choices. There are difficulties, both conceptual and practical, in providing the most useful cost estimates. Also program budgeting, unless implemented with care, may be conducive to excessive centralization of authority, which itself entails disadvantages or costs. This will be considered under institutional arrangements. Our interest here is in program budgeting as an information system to facilitate economic calculations.

Cost-benefit analysis. Increasingly nowadays there are direct attempts to prepare an economic calculus to help one choose among alternatives. These alternatives are often called systems because--whether they are physically small guidance mechanisms or vast combinations of missiles, aircraft, bases, command-and-control arrangements, personnel, and procedures--they are sets of interrelated parts. Such cost-gain comparisons are sometimes called cost-effectiveness

analyses or systems analyses, especially when they pertain to defense; operations research or operational analyses, particularly when they compare alternative modes of operation; cost-benefit analyses, originally where they evaluated natural-resource projects; or just plain economic analyses where they examine conventional economic policies. The term cost-benefit analysis is now used rather widely, and it does seem to convey the underlying idea fairly well.

Cost-benefit analyses can be viewed as consisting of several elements: (1) the desired objectives, such as (in defense) being prepared to carry out specified missions; (2) the alternative systems, or means of trying to achieve the objectives; (3) the costs entailed by each of the systems; (4) models to help trace out the costs incurred and achievements provided; and (5) a criterion (involving both cost and achievement) to identify the best system. With regard to the last element, discussing the correct way to design criteria may seem like discussing the correct way to find the Holy Grail. In a world of uncertainty and Nth best, judgments must help shape choices, and no operational test of preferredness can be above suspicion. Moreover, analyses vary in their quality (which is hard to appraise) and in their

applicability to different decisions. For these reasons, the responsible decision-makers must treat cost-benefit analyses as "consumers' research" and introduce heroic judgments in reaching final decisions. In a sense, then, it may be both presumptuous and erroneous to discuss having a test of preferredness in these quantitative analyses.

Criteria should be considered, nonetheless, in connection with such analysis. First, cost-benefit analysts must deal with a closely related set of issues: what are relevant impacts on achievement of objectives and what are relevant impacts on costs? (These issues confront one in the first four elements of cost-benefit analysis, of course, with or without any fifth element called criterion selection.) Second, cost-benefit analysts do apply criteria, especially in designing and redesigning the alternatives to be compared. They delete features that appear to be inefficient, add features that appear to be improvements, and probe for alternative combinations that are worth considering. This screening of possibilities and redesign of alternative systems entails the use of criteria, and these should be explicitly considered and exhibited. Moreover, whether or not they ought to, analysts often present the final comparisons in terms of a criterion.

Thus, while it is wrong to talk as if a definitive criterion is an element of every analysis, we ought to emphasize certain points about criterion selection. First, many tests of preferredness can be quite misleading. For example, such tests as the ratio of gains to costs, the ratio of part of the gains to part of the costs, and maximum gains for particular inputs should be avoided (Hitch & McKean 1960, pp. 158-181). Second, especially since criteria have to be used in probing for designs worthy of a decision-maker's attention, it should be stressed that good (though never perfect) criteria usually take the following forms: (1) maximum gains minus costs (wherever possible), (2) maximum achievement of an objective for a given cost, or (3) minimum cost of achieving a specified amount of an objective.

Needless to say, analyses should attempt to take into account all gains and all costs. Some people feel that there are two types of gain or cost, economic and noneconomic, and that economic analysis has nothing to say about the latter. This distinction is neither very sound nor very useful. People pay for--that is, they value--paintings as well as shoes, peace of mind as well as aluminum pans, a lower probability of death as well as

garbage disposal. The significant categories are not economic and noneconomic items but (1) gains and costs that can be measured in monetary units (e.g., production or use of items like steel that have market prices to which users can adjust their transactions); (2) other commensurable effects (e.g., impacts of better warning, on the one hand, and of hardening missile bases, on the other hand, on retaliatory capability); (3) incommensurable effects that can be quantified but not in terms of a common denominator (e.g., capability of destroying x targets and capability of showing resolve by putting y aircraft on forward bases); and (4) non-quantifiable effects. Examples of the latter are impacts on morale and thence on capability; impacts on the probability of limited-war, of escalation, and of nuclear war; impacts on the chances of working out mutually acceptable arms controls. In taking a position on an issue, each of us implicitly quantifies such considerations. But there is no way to make generally valid quantifications that would necessarily agree with those of other persons. These distinctions between types of effects of alternative policies do serve a useful purpose, especially in warning us of the limitations of cost-benefit analysis.

Another point about cost-benefit analysis is that it necessarily involves groping and the making of subjective judgments, not just briskly proceeding with dispassionate scientific measurements. No one says, "This is the defense objective, and here are the three alternative systems to be compared. Now trace out the impacts of each on cost and on achievement of the objective, and indicate the preferred system." What happens is that those making the analysis spend quite a time groping for an operational statement of the objective, such as the ability, after receiving a specified strike, to destroy a designated set of targets with a stipulated probability. A first attempt is made at designing the alternative ways of producing this capability. Preliminary costs are estimated. Members of the research team perceive that the systems would affect other objectives, such as deterring minor aggressions or providing a flexible rather than a spasm response to major aggressions. If the analysis is being made by a relatively small nation, its defense posture would have subtle and crucial impacts on the reactions of neighboring countries and of large nations. The analysts redesign the alternatives in the light of these impacts, perhaps so that each alternative performs

at least "acceptably" with respect to each objective. Next it appears that certain additional features, e.g., decoys or extra radar coverage, might add greatly to capability but not much to cost. Or the cost group reports that certain Arctic installations are extremely expensive and that relocating them might reduce costs greatly with little impairment of effectiveness. In both cases the systems have to be modified again. This cut-and-try procedure is essential. Indeed, this process of redesigning the alternatives is probably a more important contribution than the final cost-effectiveness exhibits. In any event, preparing such an analysis is a process of probing--and not at all a methodical scientific comparison following prescribed procedures (see Quade 1964, Chapter 3).

An appreciation of cost-benefit analysis also requires awareness that incommensurables and uncertainties are pervasive. Consider achievements of the multiple objectives mentioned above. These achievements or effects of the alternative systems can perhaps be described, but not expressed in terms of a common denominator. Judgments about the extent of these effects and their worth have to be made. Some costs--the opportunity cost of devoting resources to defense, the sacrifice of

crew lives, the impairment of morale and alertness in performing dull monotonous tasks--cannot validly be put in terms of a common denominator. Furthermore, because of uncertainties, whatever estimates can be prepared should in principle be probability distributions rather than unique figures for costs and gains. The system that performs best in one contingency may perform worst in another contingency. Again this may call for redesigning the systems to insure against catastrophic outcomes, and it definitely calls for caution in interpreting the results of cost-benefit analyses. Finally, costs and gains occur over a period of time, not at a single point in time, and there is no fully acceptable means of handling these streams in analyzing defense options. To be compared, alternative cost-gain streams must each be reduced to a single number, such as present worth. Capabilities occurring in different years can hardly be discounted satisfactorily. They must therefore be stipulated, and only the cost streams discounted. But when the time path or anything else is stipulated, this implies that there are no trade-offs. Also, discounting the cost streams alone poses some problems. For example, most persons would be inclined to discount riskier proposals at higher rates--but with the gains stipulated,

this would make the riskier proposals relatively cheap and attractive! (For more detail on the difficulties regarding incommensurables, uncertainties, and time, see Hitch & McKean 1960, Chapters 10 and 11.)

These difficulties are present because life is complex and choice is hard. They are not created by cost-benefit analysis. Moreover, they do not render such quantitative economic analysis helpless. They simply mean that we have to be discriminating about when and how to use various tools. Cost-benefit analyses are less helpful in applications where uncertainties are great, as in the case of choosing between disarmament options or between exploratory research and development proposals. They are less helpful where incommensurables are highly significant, as in selecting the sizes of defense programs. They are more helpful in choosing between certain force structure alternatives, such as alternative mixes of Polaris and Minute-man or alternative base locations.

Perhaps the main conclusion, however, is that we must always regard analyses as aids or inputs to decisions, not as oracular touchstones. (And, needless to say, fragments of cost-benefit analyses, interaction models, games that force people to consider the reactions of allies and enemies, improvements

in computational and analytical techniques--any activities that help shed light on costs or gains--are also inputs to decisions and can help increase economic efficiency in defense.) Even the most comprehensive cost-benefit analyses must be interpreted, not applied mechanically. If employed cautiously, and with institutional checks and balances to insure against misuse, cost-benefit analyses can be quite useful. They can sometimes help to eliminate really bad choices, leaving the decision-makers to choose from a shorter list of reasonably good options. They can sometimes point with considerable clarity to improvements, even though neither they nor any other techniques can identify truly optimal choices. Most important of all, cost-benefit analyses can provide the right framework for decision-makers, bargainers, or anyone else "to think by." It is the right kind of framework to use in organizing the evidence and one's thoughts and intuitions regarding alternatives.

#### Institutional Arrangements and Economizing

In defense as in other problems of choice we must recognize that factors other than information and exhortation play a role in shaping actual choices. The hypothesis that each individual maximizes his

own utility should be kept in mind, and the way that rules and institutions shape the costs and rewards confronting individuals should be recognized.

The utility-maximization hypothesis does not imply that people are extremely selfish, brutish, or anything of the sort. It merely holds that individuals get satisfaction from many things--play, material goods, spiritual well-being, helping others--and that these things are to some extent substitutes for each other. That being the case, if the cost to consumers or officials of one item or action increases, they will demand less of it and more of other things. An increase in the rewards to officials or other individuals from one item or action will cause them to demand more of it and less of other items. (On the utility-maximization hypothesis, see Alchian & Allen 1964, Chapter 2.) This general theorem can lead to many testable hypotheses regarding both private and public activities, including defense.

Models of the private economy make use of this hypothesis, and they yield many good predictions. No one consciously considers shifting resources from the railroad industry to television, yet with certain institutional arrangements resources get shifted about in a fairly sensible way. With different

institutional arrangements, e.g., with compulsion and theft permitted, the outcome would be quite different (even if vast numbers of sound cost-benefit analyses were available).

In the private sector of the economy, the price mechanism causes individuals to feel most of the costs and gains from their actions. In the public sector the bargaining mechanism, though a very imprecise instrument, performs some of the same function (Lindblom 1955). If a decision-maker contemplates an action, he will consider some of the costs he would impose on others, at least on those who have the power to retaliate. He will consider some of the gains he would bestow on others, at least on those from whom he can bargain for favors. If control is highly centralized, it has certain advantages, but it also means that top management can more readily neglect such spillover costs and gains. If there are checks and balances, there is a more comprehensive bargaining network, and top management is impelled to take more of the costs and gains into account. In any organization, there is a whole spectrum of possible bargaining arrangements, each with its own advantages and disadvantages.

These points are pertinent to defense planning. A high degree of centralization brings some advantages,

but it also means less dispersal of bargaining power and may ultimately permit the neglect of important considerations (McKean & Schlesinger 1964). In a defense department, as in any bureaucracy, there are natural tendencies to centralize authority. With five-year program budgeting, this tendency may be reinforced unless we guard against it. The defense minister or chief may wish to coordinate interrelated choices, but if the military branches have the authority to allocate their own budgets, they will do much as they please anyway. So the program budget may become, not an information system, but an approved five-year plan that serves as an instrument of control.

This arrangement can correct some of the bad features of the rivalry between military branches in shaping programs that are interrelated. But gains attributable to centralization (or imperfections in the bargaining between rival branches) do not automatically mean that centralization is an improvement. For it brings also some ill effects or costs, which should be weighed against the gains. With centralization, one set of views plays a greater role in decision-making, and dissenting views play lesser roles. In other words, there are fewer checks

and balances on the views of the central group. Also if central managers try to control in much detail, they find it imperative to simplify decision-making and to make changing the program rather difficult. Finally, lower-level incentives to dissent and criticize and urge changes may diminish if such activities begin to be unrewarding. All these forces can, in the long run, produce disadvantages: (1) the suppression of alternatives; (2) a neglect of part of the costs and gains from alternative policies; and (3) a neglect of uncertainties.

One group's view of the future will be less diversified than the separate judgments of a multiplicity of groups. Dominance of one group will tend to discard tradeoffs and options that others may take seriously, to treat certain costs and gains more lightly than others would, and to regard a particular subset of contingencies and uncertainties as being the major ones. The need to simplify--to use half-page summaries and rules of thumb--strengthens these same tendencies. They may be further reinforced by a loss of incentives at lower levels, perhaps by tacit agreements to refrain from rocking the boat. For some choices, such as force-structure decisions that have crucial interrelationships, central control is appropriate.

For other choices, such as exploratory research and development decisions that are dominated by uncertainty, a greater degree of decentralization may be appropriate.

We need to learn more about institutional arrangements for harnessing the efforts of individuals to promote various objectives. We have much to learn about the effects on incentives of alternative bargaining structures, procedures, "rules of the game," relationships between defense agencies and contractors, and so on. In the U.S. Department of Defense and in various nations, numerous institutional modifications are being tried, such as organizational changes, program budgeting, incentive contracts, contracts in which value engineering savings are shared, and stock funds under which certain activities are managed almost like private businesses (Hitch & McKean 1960, Chapter 12). In the long run institutional arrangements will turn out to be fully as important as the use of an economic calculus in improving defense choices.

BIBLIOGRAPHY

Alchian, Armen A.; and Allen, William R. 1964

University economics. Belmont, California:

Wadsworth Publishing Co.

Davis, Otto A.; and Whinston, Andrew B. 1963

Welfare economics and the theory of second

best. Paper jointly sponsored by Cowles

Commission for Research in Economics and

the Graduate School of Industrial

Administration of the Carnegie Institute

of Technology (mimeographed).

Devons, Ely 1950 Planning in practice: essays

in aircraft planning in war-time. Cambridge:

Cambridge Univ. Press.

Enke, Stephen 1954 Some economic aspects of

fissionable material. Quarterly Journal of

Economics 68:217-232.

Enthoven, Alain C.; and Rowen, Harry S. 1961

Defense planning and organization. Pages

365-417 in Public finances: needs, sources,

and utilization, a report of the National

Bureau of Economic Research, Princeton, N.J.:

Princeton University Press.

Harris, Seymour E. 1951 The economics of mobili-

zation and inflation. New York: W. W. Norton

and Co.

- Hirshleifer, Jack 1963 Disaster and recovery:  
a historical survey. Research Memorandum  
RM-3079-PR. Santa Monica, California: The  
RAND Corporation.
- Hitch, Charles J. 1958 Economics and military  
operations research. Review of Economics and  
Statistics 40:199-209
- Hitch, Charles J.; and McKean, Roland N. 1960  
The economics of defense in the nuclear age.  
Cambridge, Massachusetts: Harvard Univ. Press.
- Hitch, Charles J. 1963 Plans, programs, and  
budgets in the Department of Defense, Opera-  
tions Research 11:1-17.
- Hoag, Malcolm W. 1959 Some complexities in mili-  
tary planning. World Politics 11:553-576.
- Klein, Burton H.; and Meckling, William H. 1958  
Application of operations research to develop-  
ment decisions. Operations Research 6:352-363.
- Knorr, Klaus 1956 The war potential of nations.  
Princeton, N.J.: Princeton University Press.
- Levine, Robert A. 1963 The arms debate. Cam-  
bridge, Massachusetts: Harvard Univ. Press.
- Lincoln, George A. 1954 Economics of national  
security. 2nd ed. New York: Prentice-Hall.
- Lindblom, Charles E. 1955 Bargaining: the hidden  
hand in government. Research Memorandum  
RM-1434-RC. Santa Monica, California: The  
RAND Corporation.

Marshall, Andrew W.; and Meckling, William H.

1962 Predictability of the costs, time, and success of development. Pages 461-475 of The rate and direction of inventive activity: economic and social factors. A report of the National Bureau of Economic Research.

Princeton, N.J.: Princeton Univ. Press.

Massé, Pierre 1959 Le choix des investissements: criteres et methodes. Paris: Dunod & Co.

McKean, Roland N. 1963 Cost-benefit analysis and British defence expenditure. Pages 17-35 in Peacock, Alan T.; and Robertson, D.J. (editors), Public expenditure appraisal and control. Edinburgh: Oliver & Boyd. (Reprinted from Scottish Journal of Political Economy 10:17-35).

McKean, Roland N.; and Schlesinger, James R. 1964 Defense planning and budgeting. (Forthcoming)

Nelson, Richard R. 1961 Uncertainty, learning, and the economics of parallel research and development efforts. Review of Economics and Statistics 43:351-364.

Novick, David 1954 Which program do we mean in 'program budgeting?' P-530. Santa Monica, California: The RAND Corporation

Peck, Merton J.; and Scherer, Frederic M. 1962 The weapons acquisition process: an economic analysis. Boston: Division of Research, Graduate School of Business Administration, Harvard University.

- Quade, E. S. (editor) 1964 Analysis for military decisions. Chicago: Rand McNally.
- RAND Corporation 1958 Report on a study of non-military defense. Report R-322-RC.
- Robbins, Lionel 1947 The economic problem in peace and war. London: Macmillan and Co.
- Schelling, Thomas C. 1960 The strategy of conflict. Cambridge, Massachusetts: Harvard Univ. Press.
- Scherer, Frederic M. 1964 The weapons acquisition process: economic incentives. Boston: Division of Research, Graduate School of Business Administration, Harvard University.
- Schlesinger, James R. 1960 The political economy of national security. New York: Frederick A. Praeger.
- Schlesinger, James R. 1963 Quantitative analysis and national security. World Politics 15:295-315.
- Smithies, Arthur 1955 The budgetary process in the United States. New York: McGraw-Hill Book Co.